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N. S. Shasha'a

W. F. Campbell

William P. Nye
Utah State University

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Effects of Fertilizer and Moisture on Seed Yield of Onion¹

N. S. Shasha'a², W. F. Campbell, and W. P. Nye³

Plant Science Department, Utah State University, Logan, UT 84322

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Abstract. Inbred onions, *Allium cepa* L., were grown with different levels of fertilizer and soil moisture to determine treatment influence on seed yield. Nitrogen (253 kg/ha) alone or in combination with P (162 kg/ha) reduced plant survival, umbels per plant, pollination index, and seed yield where soil moisture was low but the reduction was nil or not as severe where soil moisture was high.

When soil moisture is low, N at high levels may decrease seed yields in onions. Moreover, N may interact with other fertilizers such as P and may intensify

adverse effects at low soil moisture. Hawthorn (8) and MacGillivray (9) demonstrated that high soil moisture consistently resulted in high onion seed yields. Drinkwater and Janes (6) reported that regular irrigation increased the yield of onion bulbs. Various studies with crops other than onions lists 3 critical stages at which seed yields could be reduced by water stress: floral initiation and inflorescence development when the potential seed number is determined (5, 7, 10, 12, 15); anthesis and fertilization when the degree to which this potential is realized is fixed (5, 12); and seed filling when seed wt progressively increases (1, 2, 4, 16). Riekels (11) observed a decline in onion bulb yields with

increasing amounts of N at low moisture levels. With high moisture levels yields increased with each increase in N.

Shasha'a et al. (14) reported that onion seed yields were influenced by interactions among umbels per plant, flowers per umbel, fertilized flowers per umbel, and seeds per fertilized flower, as well as environmental factors. This paper reports the influence of fertilizer and moisture levels and their interactions on onion seed yield.

Two onion inbreds, B2267A and B2215C, were planted in Millville silt loam on the Greenville farm of Utah State Univ., Logan. Three different factors at 2 levels each were tested in a split-plot randomized block design with 4 replications. The main plots were devoted to testing moisture levels: low (not irrigated) and high (irrigated weekly). The sub-plots were for fertilizer treatments: none, N at 253 kg/ha, P at 162 Kg/ha and N and P together at these rates. Both fertilizers were placed in a narrow strip at the bottom of furrows opened for planting. The bulbs were placed on top of the fertilizers and the furrows were then closed. The fertilizers were applied this way to test for possible stress effects that could subsequently be reflected on onion seed yield.

Honey bees at the rate of 16 colonies/ha were placed on the east side of

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²Now Head of Horticultural Research Department, Amman, Jordan.

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the plots when the onions were about 25% in bloom. All species of pollinating insects were counted between 10:00 and 12:00 AM and between 2:00 and 4:00 PM daily during the peak blooming period. A pollination efficiency rating for each pollinator species was assigned by estimating the quantity of loose pollen grains from a representative sample of insects and combining this factor with the size, hairiness, and activity pattern (3). The insect pollinators, with their pollination efficiencies were as follows: nectar-collecting honey bees—2; pollen-collecting honey bees—4, *Andrena prunorum* Cockerell—5, *Halictus farinosus* Smith—5, and *Nomia melanderi* Cockerell—5; all other bees—3.5; wasps—1; large Diptera—4; small Diptera—0.5; and all other insects—1. This type of rating is admittedly subjective, but when it is multiplied by the populations to give a pollination index (PI), it can give a more valid picture than population figures alone (3). The pollination index was computed per 100 umbels (13).

Tensiometers with vacuum gauge readings of 0–100 were placed 15 and 30 cm deep. To express suction pressure the percentages of moisture were converted to bars through the use of a soil water characteristic curve for the location.

In the non-irrigated plots, the male-sterile inbred, B2267A, exhibited highly significant reductions in plants and seed yields per row when an additional 253 kg N/ha was added compared to the control plants (Table 1). When 162 kg P/ha was added to the low moisture plots the no. of umbels per plant and seed yields per row were reduced. Combined applications of N and P at these rates reduced all components of yield and also PI.

When B2267A was grown on high soil moisture plots, the addition of N significantly reduced umbels per plant, PI, and seed yields per row (Table 1). When P alone was added there was essentially no difference in survival of the no. of plants per row. Umbels per plant and PI values increased slightly compared to the controls. However, there was a significant increase in the seed yields per row on plots that received extra P. The combined fertilizers reduced the no. of umbels per plant and seed yields per row.

On low moisture plots the male-fertile inbred, B2215C, had fewer plants surviving per row and lower seed yields per row when N alone was added (Table 1). When P alone was added under a low irrigation regime, B2215C underwent only slight reductions in the various components of yield and in seed yields per row. Combined N and

Table 1. Responses of seed yield and the components of seed yield in inbred lines of *Allium* to fertilizer and moisture.

Moisture	Fertilizer ²	Plants per row	Umbels per plant	PI	Seed yield (g)
B2267A					
Low	None	33.0 a	3.75 ab	33.8 ab	302.9 c
	N	21.5 b	3.84 ab	38.3 a	192.4 ef
	P	32.5 a	3.47 b	35.0 a	271.4 cd
	N + P	21.8 b	3.10 c	30.3 bc	129.4 f
High	None	33.0 a	3.97 a	34.7 ab	397.0 ab
	N	27.3 ab	3.05 c	28.3 c	213.7 de
	P	32.8 a	4.09 a	40.3 a	427.0 a
	N + P	29.0 a	3.60 ab	35.5 a	314.1 bc
B2215C					
Low	None	33.3 a	2.29 a	60.0 ab	169.7 b
	N	18.5 b	2.05 a	66.0 a	84.8 c
	P	33.0 a	2.27 a	56.0 ab	157.4 b
	N + P	16.0 b	1.97 b	55.3 ab	60.3 d
High	None	35.0 a	2.34 a	60.5 ab	262.0 a
	N	12.8 b	2.14 a	44.8 b	68.8 c
	P	34.0 a	2.36 a	57.3 ab	262.9 a
	N + P	18.5 b	2.19 a	61.8 a	113.0 bc

²N at 253 kg/ha; P at 162 kg/ha.

³Mean separation in columns within inbreds by Duncan's multiple range test, 5% level.

P, however, produced significant reductions in plants and seed yields per row and in umbels per plant. Under low moisture the various fertilizer treatments induced only slight changes in PI.

With a weekly irrigation regime, B2215C exhibited significant reductions in plants, seed yields, and in PI on the N plots (Table 1). Adding P alone produced a very slight reduction in plants per row and PI, and a very slight increase in umbels per plant and in seed yields per row when compared to the controls. When N and P were combined on weekly irrigated plots, B2215C exhibited highly significant reductions in plants that survived and seed yields per row as compared to the controls, with essentially no difference in no. of umbels per row and in PI.

Our data indicate that mineral fertilizers such as N and P in supraoptimum amounts may decrease onion seed yields, especially when soil moisture is low (Table 1). Our data agree with those of others (8, 9, 11) and suggest prudent use and proper placement of fertilizers.

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